# frivol

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# Contents

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# Class Index

## 1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

# Chapter 2

# Class Index

## 2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

# Chapter 3

# Class Documentation

## 3.1 frivol::fortune::Algorithm< PolicyT > Class Template Reference

`#include <fortune.hpp>`

### Public Types

- typedef PolicyT::Coord **CoordT**
- typedef Point< CoordT > **PointT**

### Public Member Functions

- Algorithm (const containers::Array< PointT > &sites)
- void step ()

  *Runs the algorithm one event handling forward.*
- CoordT getSweeplineY () const
- bool isFinished ()

  *Returns true if the algorithm has finished.*
- void finish ()

  *Steps the algorithm until the end.*
- int getVoronoiVertexCount () const

  *Returns the number of Voronoi vertices met in the algorithm.*

### 3.1.1 Detailed Description

**template<typename PolicyT = DefaultPolicy>class frivol::fortune::Algorithm< PolicyT >**

State of Fortune's algorithm.

**Template Parameters**

| | |
|---|---|
| *PolicyT* | The algorithm policy to use, instance of Policy template. |

### 3.1.2 Constructor & Destructor Documentation

#### 3.1.2.1 template<typename PolicyT > frivol::fortune::Algorithm< PolicyT >::Algorithm ( const containers::Array< PointT > & *sites* )

Constructs algorithm state.

**Parameters**

| | |
|---|---|
| *points* | Reference to the input set of sites. The object must exist throughout the existence of the Algorithm. |

### 3.1.3 Member Function Documentation

#### 3.1.3.1 template<typename PolicyT > PolicyT::Coord frivol::fortune::Algorithm< PolicyT >::getSweeplineY ( ) const

Returns the sweepline Y coordinate of last step(). Undefined return value if step() has not been called yet.

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/fortune.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/fortune_impl.hpp

## 3.2 frivol::fortune::Arc Struct Reference

Information of an arc in BeachLine.

`#include <beach_line.hpp>`

### Public Attributes

- Idx site

  *The index of the site from which the arc originates.*
- Idx arc_id

  *The ID of the arc.*

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/beach_line.hpp

## 3.3 frivol::containers::Array< T > Class Template Reference

`#include <array.hpp>`

### Public Member Functions

- Array (Idx size)
- Idx getSize () const

  *Returns the size of the array.*
- void resize (Idx size)

- const T & operator[] (Idx index) const
- T & operator[] (Idx index)

### 3.3.1 Detailed Description

template<typename T>class frivol::containers::Array< T >

Simple fixed-size array.

**Template Parameters**

| | |
|---|---|
| *T* | The type of stored elements. Should be default constructible. |

### 3.3.2 Constructor & Destructor Documentation

#### 3.3.2.1 template<typename T > frivol::containers::Array< T >::Array ( Idx *size* )

Creates an array with all elements default-constructed.

**Parameters**

| | |
|---|---|
| *size* | The size of the array. |

### 3.3.3 Member Function Documentation

#### 3.3.3.1 template<typename T > const T & frivol::containers::Array< T >::operator[] ( Idx *index* ) const

Returns reference to an element in the array.

**Parameters**

| | |
|---|---|
| *index* | The zero-based index of the element. |

**Exceptions**

| | |
|---|---|
| *std::out_of_range* | if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows. |

#### 3.3.3.2 template<typename T > T & frivol::containers::Array< T >::operator[] ( Idx *index* )

Returns reference to an element in the array.

**Parameters**

| | |
|---|---|
| *index* | The zero-based index of the element. |

**Exceptions**

| | |
|---|---|
| *std::out_of_range* | if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows. |

#### 3.3.3.3 template<typename T > void frivol::containers::Array< T >::resize ( Idx *size* )

Resizes the array to size. If size decreases the extra elements are removed. If size increases, the new elements are default-constructed. The operation may assign the current elements to a new place, and therefore pointers to the array may be invalidated.

**Parameters**

| | |
|---|---|
| *size* | The new size. |

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/array.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/containers/array_impl.hpp

## 3.4 frivol::fortune::BeachLine< PolicyT > Class Template Reference

`#include <beach_line.hpp>`

### Public Types

- typedef PolicyT::Coord **CoordT**
- typedef Point< CoordT > **PointT**

### Public Member Functions

- BeachLine (const containers::Array< PointT > &sites, Idx max_arcs)
- Idx getMaxArcCount () const
- std::pair< Idx, Idx > insertArc (Idx site, const CoordT &sweepline_y)
- void removeArc (Idx arc_id)
- Idx getLeftArc (Idx arc_id) const
- Idx getRightArc (Idx arc_id) const
- Idx getOriginSite (Idx arc_id) const

### 3.4.1 Detailed Description

**template<typename PolicyT>class frivol::fortune::BeachLine< PolicyT >**

The advancing sweepline of Fortune's algorithm. Consists of parabolic arcs that are defined to be the curves that have equal distances from an input site and from the sweepline. Adjacent arcs are separated by their intersection points called breakpoints.

The arcs of the beach line are identified by numerical arc IDs. The maximum number of arcs in the beach line must be specified in advance.

**Template Parameters**

| | |
|---|---|
| *PolicyT* | The algorithm policy to use, instance of Policy template. |

### 3.4.2 Constructor & Destructor Documentation

#### 3.4.2.1 template<typename PolicyT > frivol::fortune::BeachLine< PolicyT >::BeachLine ( const containers::Array< PointT > & *sites*, Idx *max_arcs* )

Constructs BeachLine.

**Parameters**

| | |
|---|---|
| *sites* | The input sites for the algorithm. |
| *max_arcs* | The number of arcs the beach line must be able to contain. |

### 3.4.3 Member Function Documentation

#### 3.4.3.1 template<typename PolicyT > Idx frivol::fortune::BeachLine< PolicyT >::getLeftArc ( Idx *arc_id* ) const

Returns the ID of the arc left from given arc.

**Parameters**

| | |
|---|---|
| *arc_id* | ID of the arc. |

**Returns**

arc ID of the arc to the left from arc_id, or nil_idx if arc_id is the leftmost arc.

#### 3.4.3.2 template<typename PolicyT > Idx frivol::fortune::BeachLine< PolicyT >::getMaxArcCount ( ) const

Gets the maximum number of arcs there can be in the beach line. The arc IDs are in 0, ..., getMaxArcCount()-1.

#### 3.4.3.3 template<typename PolicyT > Idx frivol::fortune::BeachLine< PolicyT >::getOriginSite ( Idx *arc_id* ) const

Returns the index of the origin site of given arc.

**Parameters**

| | |
|---|---|
| *arc_id* | ID of the arc. |

#### 3.4.3.4 template<typename PolicyT > Idx frivol::fortune::BeachLine< PolicyT >::getRightArc ( Idx *arc_id* ) const

Returns the ID of the arc right from given arc.

**Parameters**

| | |
|---|---|
| *arc_id* | ID of the arc. |

**Returns**

arc ID of the arc to the right from arc_id, or nil_idx if arc_id is the rightmost arc.

#### 3.4.3.5 template<typename PolicyT > std::pair< Idx, Idx > frivol::fortune::BeachLine< PolicyT >::insertArc ( Idx *site*, const CoordT & *sweepline_y* )

Adds arc to the right place in the beach line. The arc ending up under the new arc is split in two.

**Parameters**

| | |
|---|---|
| *site* | The origin site of the arc. |
| *sweepline_y* | The Y-coordinate of the sweep line that defines the parabolas. |

**Returns**

pair consisting of the ID of the new arc and the ID of the arc on which it was placed and that was split in two (the returned part being on the right of the new arc), or nil_idx if the beach line was empty.

**Exceptions**

| | |
|---|---|
| *std::logic_error* | if the maximum number of arcs (getMaxArcCount()) are already in use. |

#### 3.4.3.6 template<typename PolicyT > void frivol::fortune::BeachLine< PolicyT >::removeArc ( Idx *arc_id* )

Removes arc from the beach line.

**Parameters**

| | |
|---|---|
| *arc_id* | The ID of the arc to remove. |

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/beach_line.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/fortune/beach_line_impl.hpp

## 3.5 frivol::containers::priority_queues::DummyPriorityQueue< PriorityT > Class Template Reference

Simple implementation of PriorityQueueConcept.

`#include <dummy_priority_queue.hpp>`

### Public Member Functions

- **DummyPriorityQueue** (Idx size)
- std::pair< Idx, PriorityT > **pop** ()
- bool **empty** () const
- void **setPriority** (Idx key, PriorityT priority)
- void **setPriorityNIL** (Idx key)

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/priority_queues/dummy_priority_queue.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/containers/priority_queues/dummy_priority_queue_impl.hpp

## 3.6 frivol::containers::search_trees::DummySearchTree< ElementT > Class Template Reference

Simple implementation of SearchTreeConcept (a wrapper around std::list).

`#include <dummy_search_tree.hpp>`

### Public Types

- typedef std::list< ElementT >
  ::iterator **Iterator**

### Public Member Functions

- template<typename FuncT >
  Iterator **search** (FuncT func)

The documentation for this class was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/search_trees/dummy_search_tree.hpp

## 3.7 frivol::GeometryTraits< CoordT > Struct Template Reference

`#include <geometry_traits.hpp>`

### 3.7.1 Detailed Description

**template<typename CoordT>struct frivol::GeometryTraits< CoordT >**

Traits class that gives needed geometry operations for the algorithm. Implemented traits are required by Policy.

**Template Parameters**

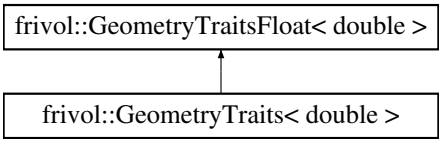
| | |
|---|---|
| *CoordT* | The coordinate type to use. |

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp

## 3.8 frivol::GeometryTraits< double > Struct Template Reference

Inheritance diagram for frivol::GeometryTraits< double >:



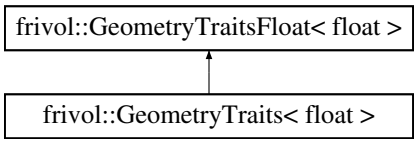

### Additional Inherited Members

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp

## 3.9 frivol::GeometryTraits< float > Struct Template Reference

Inheritance diagram for frivol::GeometryTraits< float >:




### Additional Inherited Members

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp

## 3.10 frivol::GeometryTraitsFloat< CoordT > Struct Template Reference

`#include <geometry_traits.hpp>`

### Public Types

- typedef Point< CoordT > **PointT**

### Static Public Member Functions

- static CoordT **getBreakpointX** (const PointT &a, const PointT &b, CoordT topy, bool positive_big)
- static PointT **getCircumcenter** (const PointT &a, const PointT &b, const PointT &c)
- static CoordT **getCircumcircleTopY** (const PointT &a, const PointT &b, const PointT &c)
- static bool **isCCW** (const PointT &a, const PointT &b, const PointT &c)

### Static Public Attributes

- static constexpr CoordT **epsilon** = 1e-30

### 3.10.1 Detailed Description

**template<typename CoordT>struct frivol::GeometryTraitsFloat< CoordT >**

Implementation of GeometryTraits for floating point coordinate types (float and double).

The documentation for this struct was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits_impl.hpp

## 3.11 frivol::GeometryTraitsImplementedConcept< CoordT > Class Template Reference

`#include <geometry_traits.hpp>`

### 3.11.1 Detailed Description

template<typename CoordT>class frivol::GeometryTraitsImplementedConcept< CoordT >

Concept for checking that all required GeometryTraits are implemented for given coordinate type. Required operations are:

- CoordT getBreakpointX( Point<CoordT> a, Point<CoordT> b, CoordT topy, bool positive_big) returns the X coordinate of intersection of the two parabolas defined by (x-a.x)^2 + (y-a.y)^2 = (y-topy)^2 = (x-b.x)^2 + (y-b.y)^2 The function may assume that a.x <= b.x, a.y <= topy and b.y <= topy. The function should choose the solution where the parabola around a goes under the parabola around b. In cases where this does not happen, the result should be very big number, positive if positive_big, otherwise negative.
- Point<CoordT> getCircumcenter(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c) returns the center point of the circumscribed circle around triangle 'abc'.
- CoordT getCircumcircleTopY(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c) returns the Y coordinate of the top point (i.e. highest Y coordinate) of the circumscribed circle around triangle 'abc'.
- bool isCCW(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c) returns true if triangle 'abc' is oriented counterclockwise.

**Template Parameters**

| | |
|---|---|
| *CoordT* | The coordinate type. |

The documentation for this class was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/geometry_traits.hpp

## 3.12 frivol::Point< CoordT > Struct Template Reference

`#include <point.hpp>`

### Public Member Functions

- Point (CoordT x, CoordT y)
- Point ()

  *Constructs point with undefined values as coordinates.*

### Public Attributes

- CoordT x

  *The X coordinate of the point.*
- CoordT y

  *The Y coordinate of the point.*

### 3.12.1 Detailed Description

template<typename CoordT = double>struct frivol::Point< CoordT >

Two-dimensional point.

**Template Parameters**

| | |
|---|---|
| *CoordT* | The coordinate type to use. Should be default constructible. Defaults to double, which is the coordinate type of DefaultPolicy. |

### 3.12.2 Constructor & Destructor Documentation

#### 3.12.2.1 template<typename CoordT = double> frivol::Point< CoordT >::Point ( CoordT *x*, CoordT *y* ) [inline]

Constructs point with given coordinates.

**Parameters**

| | |
|---|---|
| *x* | The X coordinate. |
| *y* | The Y coordinate. |

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/point.hpp

## 3.13 frivol::Policy< CoordT, EventPriorityQueueT, BeachLineSearchTreeT > Struct Template Reference

`#include <policy.hpp>`

### Public Types

- typedef CoordT **Coord**

### 3.13.1 Detailed Description

template<typename CoordT, template< typename PriorityT > class EventPriorityQueueT, template< typename ElementT > class BeachLineSearchTreeT>struct frivol::Policy< CoordT, EventPriorityQueueT, BeachLineSearchTreeT >

Policy class for the Fortune's algorithm, specifying data types and data structures to use.

**Template Parameters**

| | |
|---|---|
| *CoordT* | The coordinate type to use. Should be ordered and default constructible to undefined value. Should have specialization of GeometryTraits. |
| *EventQueueT* | The priority queue type for events. Must conform to PriorityQueueConcept. |
| *BeachLineT* | The search tree to use for the "beach line" of arcs. Must conform to SearchTreeConcept. |

The documentation for this struct was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/policy.hpp

## 3.14 frivol::containers::PriorityQueueConcept< X, PriorityT > Class Template Reference

`#include <priority_queue_concept.hpp>`

### 3.14.1 Detailed Description

template<typename X, typename PriorityT>class frivol::containers::PriorityQueueConcept< X, PriorityT >

Concept checking class for priority queues X with priority values of type PriorityT (or NIL). Priority queues are initialized with given size, and contain priority values for keys 0, 1, ..., size-1. Initially, all priority values are NIL. X must support the following operations:

- <construct>(Idx size) creates priority queue for keys 0, 1, ..., size-1.
- bool empty() const returns true if all keys have NIL priority.
- std::pair<Idx, PriorityT> pop() returns pair of a key with lowest non-NIL priority and its priority and sets the priority to NIL.
- void setPriority(Idx key, PriorityT priority) sets the priority value of 'key' to non-NIL value 'priority'.
- void setPriorityNIL(Idx key) sets the priority value of key 'key' to NIL.

X may assume that PriorityT is ordered with <-operator. X may have undefined behavior if supplied keys are out of range or if pop() is called when empty() returns true.

The documentation for this class was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/priority_queue_concept.hpp

## 3.15 frivol::containers::SearchTreeConcept< X, ElementT > Class Template Reference

`#include <search_tree_concept.hpp>`

### Public Types

- typedef X::Iterator **IteratorT**

### 3.15.1 Detailed Description

template<typename X, typename ElementT>class frivol::containers::SearchTreeConcept< X, ElementT >

Concept checking class for search trees X for elements of type ElementT. Search trees are sequence containers, the elements of which are iterated using iterator objects of type X::Iterator. The iterator must be a standard bidirectional iterator. X must support the following operations:

- <construct>() creates empty search tree.
- bool empty() const retuns true if the search tree is empty.
- Iterator begin() returns the iterator of the first element (or past-the-end if empty).
- Iterator end() returns the iterator past the last element.
- template<typename FuncT> Iterator search(FuncT func) searches the sequence using the supplied int(-Iterator)-function that for given iterator iter returns negative if the searched element is before iter, positive if it is after iter, and 0 if iter is the right element. If an element such that func returns 0 is found, it is returned, otherwise end() is returned.
- void erase(Iterator iter) removes element at iter. Other iterators should not be invalidated.
- Iterators insert(Iterator iter, const ElementT& elem) inserts elem before iter and returns the iterator of the new element. Does not invalidate any iterators.

X may assume that ElementT is copy constructible.

The documentation for this class was generated from the following file:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/search_tree_concept.hpp

## 3.16 frivol::containers::Stack< T > Class Template Reference

`#include <stack.hpp>`

### Public Member Functions

- Stack ()

  *Constructs empty stack.*
- bool empty () const

  *Returns true if the stack is empty.*
- T & top ()
- void pop ()

  *Removes the top element of the stack. Call only if empty() is false.*
- void push (const T &element)

### 3.16.1 Detailed Description

**template<typename T>class frivol::containers::Stack< T >**

Stack of elements.

**Template Parameters**

| | |
|---|---|
| *T* | The type of stored elements. Should be default constructible. |

### 3.16.2 Member Function Documentation

#### 3.16.2.1 template<typename T> void frivol::containers::Stack< T >::push ( const T & *element* )

Pushes element to the top of the stack.

**Parameters**

| | |
|---|---|
| *element* | The element to push. |

#### 3.16.2.2 template<typename T > T & frivol::containers::Stack< T >::top ( )

Returns reference to the top element of the stack. Call only if empty() is false.

The documentation for this class was generated from the following files:

- /home/topi/unison/Asiakirjat/frivol/frivol/containers/stack.hpp
- /home/topi/unison/Asiakirjat/frivol/frivol/containers/stack_impl.hpp